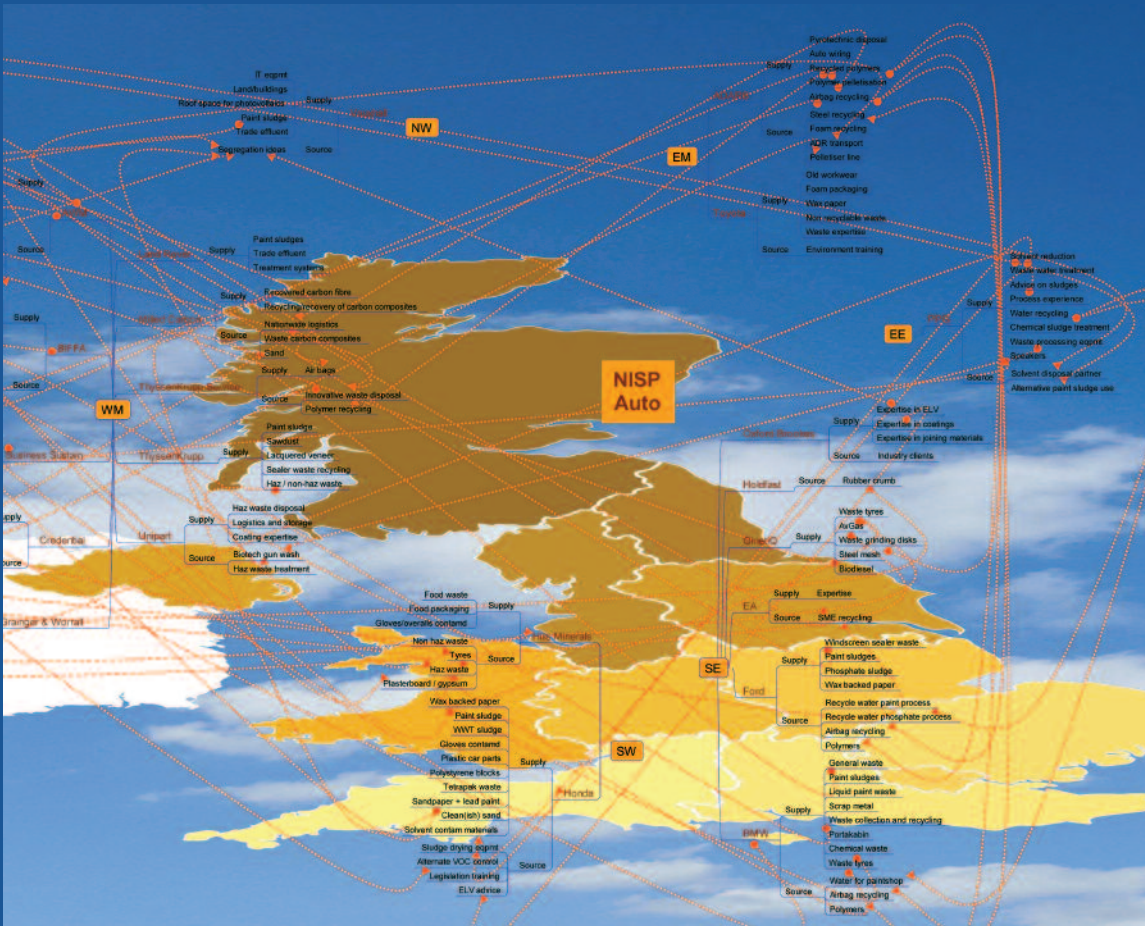


# Industrial Symbiosis in Action

Report on the Third International Industrial Symbiosis Research Symposium  
 Birmingham, England, August 5–6, 2006

D. Rachel Lombardi, School of Engineering, University of Birmingham, UK  
 Peter Laybourn, National Industrial Symbiosis Programme, UK, EDITORS



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## With Thanks and Some Envy

*Professor Marian Chertow, Center for Industrial Ecology,  
Yale School of Forestry & Environmental Studies, USA*

When we initiated the Industrial Symbiosis Research Symposium in 2004, who knew if there would ever be another? The timing must have been right, though, as the Symposia not only have continued, but also seem to improve greatly with age. The August 5-6, 2006, Birmingham Symposium, Industrial Symbiosis in Action, was as fine a meeting as I have ever attended, so with thanks and some envy (green, of course) I applaud the extraordinary role played by our host, Peter Laybourn, fearless leader of the largest industrial symbiosis program(me) in the world. Let me gratefully recognize our sponsor, Ralph Hepworth of Advantage West Midlands, who recognized the potential of bringing an analytic eye to the challenges of regional development.

The mark of a great meeting is not only good and useful content, essential, of course, but the exceptional ones do something more: they create and enhance community. In the following pages this report will tell all that any reader may wish to know about the content of the meeting. I want to describe the spirit, the comraderie, and the attention to all of our worldly needs that made us feel proud to be industrial symbiosis researchers on a quest and delighted to be in Birmingham that special weekend.

First, the logistics required us to walk from our conference hotel through the pedestrian walkways and grand city square of Birmingham. This allowed us to see that far from being sentimental about an industrial past, Birmingham was brimming with art, sculpture, and the future. The brand new conference facility was attractive, spacious, and literally let the daylight shine through so we never separated environment from our essential work. Dinner at the magnificent City Hall with Deputy Lord Mayor Mike Nangle made a grand impression on everyone. And how best to see the past and future of Birmingham on a Sunday morning? By canal boat, of course, with a narrated tour not only of the industrial symbiosis projects, but also of the history of Birmingham itself.

As material-generating as it may be, my heart was globally warmed by Peter's placement of the words "Industrial Symbiosis" on various paraphernalia. Move over university sweatshirts and hotel pens: we now have branded carrybags and large



**Chris Rogers, Ramesh Rameswamy, Marian Chertow, Rachel Lombardi and Peter Laybourn**



**Delegates are treated to a canal trip.**





capacity memory sticks that remind us time and again of what we are all about. Also, owing to the perseverance of ex-Yalie and current Birminghamite Dr. Rachel Lombardi and the support of International Synergies Limited, we have this very useful publication. Finally, all year, I have heard about connections that were made during our two days together: a book being outlined, academic programs being supported, jobs being created, and, oh yes, reduced emissions and increased material recovery wherever our band lurks.

Bravissimo. On to Toronto 2007!

*Mr. Clat*

# Acknowledgements

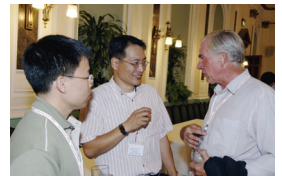
*Mr. Peter Laybourn, Programme Director, NISP, UK*

They say that with age comes wisdom – not so in my case – when will I stop volunteering (although these days it usually means volunteering others) to do things! Having said that, offering to host the 2006 Symposium was one of my better commitments for a multitude of reasons. The IS research community is stimulating to work with and the inspiration for much of what we have attempted in the National Industrial Symbiosis Programme. We are quite rightly wrapped up in what we are aiming to achieve for the health of communities and the planet; but, our attempts are often frustrated for a number of reasons, from political to technical. However, for those of us in the privileged position to be applying industrial symbiosis as practitioners it is like being in a ‘sweetie shop’. I will explain. To start a working day knowing that one could be working with any number of companies of any size, in any sector, about any resource, in any part of the country and at the end of it having contributed in some way to delivering environmental, economic and social benefits is a rare treat. Motivation personified!

Industrial Symbiosis as a term is new to many (my own initiation was 1999, as I discuss in Session 1) and is understood by even fewer. It will not remain that way. Through the efforts of the research community and practitioners, I cannot see the decade ending without industrial symbiosis being a major contributor to sustainability in most parts of the world. There is a sense of urgency like never before that practical solutions are found to address pressing environmental problems that in turn place pressure on social and economic systems (to be honest does it matter what order we place these in?) On that urgent note I would like to thank all delegates for their time and contribution, to thank those that would have dearly loved to make it but for other commitments, and a special thanks to those who made it happen, namely:

**Planning Committee:** Weslynn Ashton, Marian Chertow, Roland Clift, Noel Jacobsen, Reid Lifset, and Rachel Lombardi

**Event sponsor:**



At City Hall



Ralph Hepworth, Marian Chertow, Mike Nangle and Peter Laybourn

**Publication sponsor:**

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**Host:**



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**Co-chairs:** Professor Roland Clift of the University of Surrey, and Professor Chris Rogers of the University of Birmingham

**The NISP team:** I would especially like to thank the people I volunteered (!) for pulling it together: Marie Reynolds, Liz Quance, Will Clark, Dr. David-Huw Owen and James Woodcock.

**Thanks** to the Department for Environment, Food and Rural Affairs under their International Sustainable Consumption and Production programme for sponsoring a participant.

**Special thanks** to Deputy Lord Mayor Mike Nangle of Birmingham City Council for attending evening dinner and arranging an impromptu tour of the historic council chamber.

**And thanks** to the Yale School of Forestry & Environmental Studies Publication Series and its Editor Jane Coppock for publishing this report.



# Industrial Symbiosis: Implementing Sustainable Development

*Mr. Ralph Hepworth, Business Development Manager, Environmental Technologies Cluster, Advantage West Midlands, UK*

Advantage West Midlands were delighted to sponsor the Third International Industrial Symbiosis Research Symposium held in Birmingham in August 2006. As a Regional Development (government) Agency tasked with the economic well being of the West Midlands region of England, and having a statutory responsibility for sustainable development, industrial symbiosis has been a significant weapon in our armoury in pursuit of both of these objectives.

Our support for industrial symbiosis dates back to 2003 when some early funding led to what is now known as the UK's National Industrial Symbiosis Programme (NISP); we continue to support NISP in the West Midlands. From our regional perspective, NISP has delivered new jobs and business start ups together with reductions in the cost base of industry whilst simultaneously delivering environmental 'goods' such as diverting wastes from landfill and reducing CO<sub>2</sub> emissions. All of these benefits have been achieved for modest investment in the programme, which has shown outstanding value for money.

There is a broader contribution to economic growth as well. The core of capability that has been built up by the National Industrial Symbiosis Programme attracts new business to the region, including inward investing companies that can take advantage of the resources available as a result of the programme. Industrial symbiosis acts as an accelerator in the development of environmental technology companies, the 'solution providers' in the industrial symbiosis network, who are then better able to address export markets.

We supported the Symposium because we recognise that the practical application of industrial symbiosis has been born out of academic research, and we are proud of our small contribution in encouraging this pioneering work at an applied level. We also welcome the increasing international standing in which your work is held. We live in a global economy, with many problems in common, and the exchange of knowledge of this type can play a large part in finding common solutions. It was a particular pleasure to meet like minded people from India, China, Korea and The Philippines, amongst many others, at the symposium.

There was another particular pleasure also that came from the breadth of expertise represented at the Symposium: engineers, material scientists, social scientists and others. This deep interdisciplinary commitment was invigorating to work with and must be very relevant to today's challenges. Industrial symbiosis may be a young research field but, with this quality of interest, must have a major contribution to make, not least to Agencies like my own.

We commend the IS research community for your efforts and would urge you to continue finding the language, tools and techniques that are needed to encourage business and government to move down the paths you identify. For our part, we will continue to champion industrial symbiosis and look forward to much collaboration.

A handwritten signature in black ink, appearing to read "Paul Bell".

# Introduction and Overview

*Mr. Peter Laybourn, Director of NISP, UK, Dr. D. Rachel Lombardi, University of Birmingham, UK, Professor Roland Clift, University of Surrey, UK, and Professor Chris Rogers, University of Birmingham, UK*

## THE EVOLUTION OF A SYMPOSIUM: WHAT CHANGES . . .

Welcome to this report on the Third Annual Industrial Symbiosis Research Symposium (ISRS), held in Birmingham, UK, on 5-6 August, 2006. The first ISRS was held at Yale University 7-9 January 2004, initiated by Professor Marian Chertow and the Yale Center for Industrial Ecology.<sup>1</sup> Researchers and practitioners from 15 countries were invited to discuss the current state of knowledge in the field of IS. In 2005, the second annual Symposium took place in Stockholm, at the Royal Institute of Technology (see Appendix 3), funded by the Nordic Council of Ministers, targeting primarily the academic and research community to identify and discuss ongoing theoretical and empirical research.

The emphasis of these symposia has been on generating discussion and setting the research agenda for those studying industrial symbiosis (IS). This year's title 'IS in Action' is indicative of our progress, both in understanding and in implementing IS around the world, and perhaps appropriately held outside a university campus for the first time. Three years ago, our agenda focused on WHAT we could do; now we are examining HOW – as evidenced by our host, the UK National Industrial Symbiosis Programme, the first national IS programme in the world, now a European Eco-Innovation exemplar only 3 years in! (We should all have taken him quite seriously when Peter Laybourn introduced himself at the 2004 ISRS with “. . . and I'm here to pinch your ideas!"). Perhaps NISP is a forerunner in terms of practical implementation providing an insight into actual environmental and commercial successes of industrial symbiosis on a large scale. We also have for the first time a presentation from a major company to explain its attraction to industrial symbiosis. From 2004 and 2005 to the present, one notices a reduced focus on barriers and an increasing focus on opportunities for IS. There is an increased emphasis on engagement models to facilitate network development.

<sup>1</sup> Editors' Note: Proceedings of the First Annual Industrial Symbiosis Research Symposium on are available for free download at [http://www.environment.yale.edu/2534/current\\_titles/and](http://www.environment.yale.edu/2534/current_titles/and) <http://www.yale.edu/environment/publications>

## AND WHAT DOESN'T: THE KEY ISSUES CONTINUE

Four key issues identified in 2004 for further research and discussion continued to evolve in 2006:

- **Definition of IS**, while not a session in itself this year, arose a number of times as the group searched for common themes across geographies and economies to inform the definition of IS (see Sessions 2, 3A, 4);
- **Implementation of IS** featured centrally with our host NISP and substantial contribution from many others, academics and non-academics alike, involved in implementation throughout the world; the recurring theme of what structures (institutional, political, legal and economic) were needed to facilitate IS networks and implementation (all sessions);
- **Quantification of benefits** is of critical importance to NISP for securing their government funding, and to others making the business case for exchanges (see Sessions 1, 4) and those interested in benchmarking (see Sessions 1, 2); the distribution of benefits was discussed as well (Session 4); and
- **Role of other disciplines** featured prominently in Session 4 with particularly lively debate and active engagement around the social science contribution to understanding and advancing IS.

Additional recurring themes are addressed further in the Themes and Future Directions section:

- **Two emerging paradigms:** the planned IS paradigm being implemented in Korea and China, for example, versus the voluntary IS paradigm found in Denmark, Austria and the UK.
- **Facilitated networks and working cross sector** as mentioned above were central to every presentation.

## INDUSTRIAL SYMBIOSIS FULFILLING THE TRANSLATION ROLE

We are reminded of the adage ‘what gets measured, gets managed.’ Looking across the stakeholders involved in industrial symbiosis in the UK: the government agencies focus on climate change, economic development, and waste strategy; NISP measures outputs in metrics dictated by its funders (i.e. government) in terms of water, energy, waste, CO<sub>2</sub>, and so on; companies focus on their specific resources, be it pumice or sludge, and the regulations and costs associated with them; for IS practitioners, that water isn’t water – water is characterised by its contaminants, flow pattern and temperature – characteristics that limit or enhance its usefulness. There are a host of levels of translation going on, and yet everyone is supposed to be working toward the same goal of sustainability: companies are not accustomed (yet) to thinking in terms of climate change, and governments tend not to think about sludge, per se. There is a role for some structure, some facilitation to connect the various parties, to engage them to work toward a more sustainable outcome.

We suggest that IS could provide this facilitative role as it can move easily (with its broad community), if not seamlessly, between agents of economic and environmental policy and across all sectors of production. As was evidenced throughout the Symposium, some of the greatest challenges are around communication and the decision making processes, which requires bringing together the different agendas, finding a common language in which to communicate, agreeing upon common goals and, finally, forging a path forward.

### **‘WHY ME AND HERE’**

One of our chairpersons is faced with many of the same challenges identified above, but in a different context. Professor Chris Rogers of the University of Birmingham brings a new voice to the IS community. A geotechnical engineer, the bulk of his work still focuses on underground infrastructure, soils, and tunnelling. A few years ago, he was drawn into a project to bridge the sustainability divide – theory to implementation: understanding a complex decision making process, working toward a common language, facilitating more sustainable actions. The project, part of a national effort to advance Sustainable Urban Environments, is exploring how sustainability is incorporated (or not) into the urban regeneration process in Birmingham’s Eastside. The multi-disciplinary team (urban planner, environmental geoscientist, an infrastructure engineer and landscape designer/chartered town planner, joined in March 2006 by an industrial ecologist) works together to produce a holistic, inter-disciplinary approach to the study.

The barriers to sustainability in the field of urban regeneration may ring true to some in the field of IS: practitioners’ lack of experience, lack of certainty, lack of willingness to do things differently, lack of understanding what sustainability truly means. The current phase of research highlights path-dependency and lock-in arising from decision points in the development process – again concepts that may resonate with some in IS. Professor Rogers’ research seeks to influence the planning process – one of the frontiers of IS discussed this year (see Session 3B).

### **COMMON CHALLENGES**

Co-chair Professor Roland Clift pointed out the further similarities between Professor Rogers’ work implementing sustainability in urban regeneration and our own implementing sustainability via IS: what we’re doing isn’t always well-defined or understood, nor is the decision-making process and its stakeholders. The definition of IS will no doubt continue to be discussed, debated and refined by this community (Mr. Laybourn adds to the fray in Session 1). As for the networks that make IS happen – who are the decision makers, what motivates them – Professor Clift made the following observation. He described our most commonly cited IS example, Kalundborg, Denmark, thusly: “Looking at it as a chemical engineer, there’s technologically nothing remarkable about it whatsoever, it’s just an integrated chemical complex.” What’s remarkable is how the relationships built up that enabled different corporations in different industries to behave as if they were a single

integrated complex. The creation, development and role of networks in implementing IS was a challenge all could relate to, regardless of where on the globe they called home.

### **ROADMAP OF THE CONFERENCE REPORT**

As mentioned, the report for the 2004 ISRS are available on the web ([http://www.environment.yale.edu/2534/current\\_titles/](http://www.environment.yale.edu/2534/current_titles/) and <http://www.yale.edu/environment/publications>).

While there were no independent proceedings for 2005, a summary is provided as an appendix in this document. This year, we tried to do something different – as the Symposia have the explicit goal of setting a research agenda, we tried this year to engage with speakers and participants to create more of a group output. All Symposium attendees were invited to submit their impressions, takeaways, and thoughts from the meeting for inclusion in this report. Some speakers provided written summaries – these are presented with a brief introduction in italics preceding the speakers' contribution. For the rest, a summary was written by us based on notes, presentation slides, and the video tapes of the event.

At the end of most sections, the group's discussion and debate is synthesised in the form of research questions. We have strived to represent the contributions in a thought-provoking manner – in most cases, names have been omitted. It goes without saying, but said it must be – the insights are the group's, any mistakes are ours alone.

### **OUR MISSION, SHOULD WE CHOOSE TO ACCEPT IT**

Lest there be any doubt of the challenge we're up against with our mission of Industrial Symbiosis in Action, Professor Clift made explicit the barriers in our path right from the start: "I don't know if anyone else came here on foot this morning, but it reminded me of trying to find partners in IS: you wander around for half an hour in a light rain; there's nobody about to ask; there are no signposts – and when you finally end up, more or less by random, you are then given a map."

Let us hope that the future holds better weather, an enhanced community, and a clearer map!